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Additional Analysis of EPA's (Environmental Protection Agency's) 1984 Asbestos Survey Data

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This report presents the results of an additional analysis of data from EPA's 1984 asbestos in buildings national survey. The original survey report was entitled "Asbestos in Buildings: A National Survey of Asbestos-Containing Friable Materials," EPA Report No. 560/5-84-006.

This additional analysis was undertaken to support EPA's ongoing asbestos in buildings program. In addition to estimates provided in the original report, the additional analysis provides estimates of the number of buildings and total floor area of buildings with (a) any asbestos containing friable material (ACFM), (b) any damaged ACFM, and (c) any significantly damaged ACFM. These estimates are broken down into categories by type of ACFM, type of building, and height of building. Although condition and location of ACFM do not necessarily imply exposure to airborne asbestos, they are believed to be associated with airborne asbestos exposure.

The original survey reported that 20% of public and commercial buildings covered by the survey contain ACFM (733,000 out of 3.6 million buildings). The additional analysis estimates that a half million of these contain some damaged ACFM, and approximately 317,000 of these contain some significantly damaged ACFM. An estimated two percent of all buildings surveyed have some damaged sprayed- or trowelled-on ACFM, and an estimated nine percent have some damaged pipe wrap or boiler insulation. Details on these results and others are presented in the report.

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ADDITIONAL ANALYSIS OF EPA'S 1984 ASBESTOS SURVEY DATA

By

John Rogers
Westat, Inc.
1650 Research Boulevard
Rockville, Maryland 20850

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BATTELLE
Columbus Division - Washington Operations
2030 M Street N. W.
Washington, D. C. 20036

EPA Task Managers: Joan Blake, Bradley Schultz
EPA Project Officer: Mary Frankenberry

Design and Development Branch
Exposure Evaluation Division
Office of Toxic Substances
Office of Pesticides and Toxic Substances
US Environmental Protection Agency
Washington, D. C. 20460

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency's (EPA) Office of Toxic Substances (OTS) has an ongoing program concerning asbestos in public buildings. As part of this program, OTS completed the Asbestos in Buildings survey[1] in 1984. This survey of 231 public and commercial buildings in the continental U. S. produced estimates of the number and percent of buildings with asbestos-containing friable material[2] (ACFM); the square footage of such material; and the percent asbestos content of the material. The data collection for the survey included information on the physical condition of the ACFM. However, due to limited resources, these condition data were not analyzed as part of the original survey data analysis.

In 1986, Congress passed the Asbestos Hazard Emergency Response Act (AHERA) requiring EPA to regulate asbestos in the nation's schools and to report to Congress on the condition of asbestos-containing materials in commercial buildings and the likelihood that persons occupying such buildings are, or might be, exposed to asbestos fibers. Since the Asbestos in Buildings survey collected data related to likelihood of exposure, this additional analysis of the survey data by material condition code was completed to support EPA's report to Congress in response to AHERA.

The objective of this additional analysis of the survey data was to provide estimates for the number of buildings, floor area of buildings, and surface area of ACFM in buildings with either (a) any ACFM , (b) damaged ACFM, or (c) significantly damaged ACFM. These estimates are broken down into categories by type of asbestos-containing material, type of building, and height of building.

The major findings are summarized below. As used in this report, the term asbestos-containing friable material refers

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[1] ASBESTOS IN BUILDINGS: A National Survey of Asbestos-Containing Friable Materials, EPA 560/5-84-006, United States Environmental Protection Agency, Office of Toxic Substances, Washington, D. C. 20460, October 1984

[2] Friable material is material which can be crumbled, pulverized, or reduced to powder by hand pressure.

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collectively to sprayed-on or troweled-on friable material, ceiling tile[3], and/or pipe and boiler insulation. Results pertaining to one of these types of material specifically reference the particular material type. The term "All Buildings" refers to estimates based on survey data appropriately weighted to the defined target universe of Federal buildings, residential buildings with 10 or more dwelling units, and privately owned buildings for non-residential purposes. There are several important exclusions from this universe: primary and secondary schools (which are studied and regulated under a separate EPA program); buildings owned or occupied primarily by agencies of state and local governments; buildings built after January 1, 1979; vacant buildings; and buildings owned or operated by the military. There are estimated to be 3.6 million buildings represented by the survey results.

The figures given here are estimates and, as such, are imperfect measures. In general, survey estimates are subject to sampling error and non-sampling error. Ranges given in parentheses following the estimates represent 95 percent confidence intervals for the estimates based on the sampling error. This means that there is only a five percent chance that the actual values for the entire U. S. population fall outside this range. Qualitative conclusions comparing building type and building height categories are based on the patterns of the data across categories and have no associated confidence probability. Non-sampling error includes potential sources of bias introduced by substitution of buildings, misclassification, laboratory error, and errors in data collection, transcription, keypunching, etc. There is no evidence that non-sampling errors have contributed any substantial bias to the estimates.

The buildings in the survey were classified as containing damaged or significantly damaged ACFM based on the condition code which is defined on a relative scale from 1 (Best) to 5 (Worst). Damaged ACFM is defined as having a condition code of 3, 4, or 5, and significantly damaged asbestos having a code of 5. The categories of "Damaged" and "Significantly Damaged" correspond

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[3]Ceiling tile is usually categorized as "miscellaneous material" (e.g., the AHERA rule), and generally regarded as non-friable unless deteriorated or damaged. In this report ceiling tile is considered a friable material to be consistent with the original survey report.

approximately to the categories of "Moderate Damage" and "Significant Damage" respectively, as used in EPA's "Guidance for Assessing and Managing Exposure to Asbestos in Buildings."[4] Note that a building is classified by the most damaged asbestos-containing material of the type being tabulated and that a building can be counted in several categories. Thus, a building with significantly damaged material will be counted in tabulations for buildings with significantly damaged material, buildings with damaged material and buildings with any ACFM. Since the amount of damaged material in a building was not recorded, a building with some damaged material (at least some material with condition codes 3, 4, or 5) may also contain material in good condition (condition codes 1 and 2). Similarly, a building with some significantly damaged material may also have material in good or moderately damaged (condition codes 3 and 4) condition.

SUMMARY OF MAJOR FINDINGS

Overall

- The number of buildings (in 1,000's) with any asbestos-containing friable material by condition of material is:

Present	733	(499-966)
Some Damaged Material	501	(201-801)
Some Significantly Damaged Material	317	(<679)

- The percentage of buildings with any asbestos-containing friable material by condition of material is:

Present	20%	(14-27%)
Some Damaged Material	14%	(6-22%)
Some significantly Damaged Material	9%	(<19%)

- Taller buildings are more likely to have asbestos-containing friable material.

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[4] GUIDANCE FOR ASSESSING AND MANAGING EXPOSURE TO ASBESTOS IN BUILDINGS by Dale Keyes, Bertram Price and Jean Chesson, prepared for the EPA Office of Toxic Substances by Battelle - Washington Operations, 2030 M Street, NW, Washington, DC 20036, November 7, 1986 Draft.

- Most buildings with asbestos-containing friable material are private non-residential buildings, about half of which have one or two floors and half have three or more floors. (Note that private non-residential buildings and buildings of one or two floors are also the most common types of building covered by the survey.)

Sprayed- or trowelled-on material

- The number of buildings (in 1,000's) with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	192	(18-365)
Some Damaged Material	55	(<129)
Some significantly Damaged Material	<.5	(<1)

- The percentage of buildings with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	5%	(.5-10%)
Some Damaged Material	2%	(<4%)
Some significantly Damaged Material	<.5%	(<.5%)

- Most of the buildings with asbestos-containing sprayed- or trowelled-on friable material have one or two floors or are commercial/private non-residential. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- Most of the floor area associated with buildings with asbestos-containing sprayed- or trowelled-on friable material is in high-rise buildings (8 or more floors).

Pipe wrap and boiler insulation

- The number of buildings (in 1,000's) with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	563	(239-888)
Some Damaged Material	453	(112-793)
Some significantly Damaged Material	317	(<679)

- The percentage of buildings with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	16%	(7-25%)
Some Damaged Material	13%	(3-22%)
Some significantly Damaged Material	9%	(<19%)

- Roughly fifty-eight percent of buildings with pipe wrap or boiler insulation have asbestos-containing pipe wrap or boiler insulation.

- Of the buildings with asbestos-containing pipe wrap and boiler insulation, most appear to have damaged asbestos-containing pipe wrap or boiler insulation.

- All of the 19 high-rise buildings (8 or more floors) in the sample had asbestos-containing pipe wrap or boiler insulation.

ACFM in Public Areas

- The number of buildings (in 1,000's) with asbestos-containing friable material in public areas by condition of material is:

Present	454	(337-531)
Some Damaged Material	272	(160-384)
Some significantly Damaged Material	85	(<227)

- The percentage of buildings with asbestos-containing friable material in public areas by condition of material is:

Present	13%	(10-15%)
Damaged Material	8%	(4-11%)
Some significantly Damaged Material	2%	(<7%)

- The ACFM in public areas occurs mostly in private non-residential buildings with one or two floors. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- A higher percentage of high-rises have ACFM in public areas than do buildings with one or two floors.

ACFM in Fan/Boiler Rooms

- The number of buildings (in 1,000's) with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	462	(145-779)
Some Damaged Material	360	(33-688)
Some significantly Damaged Material	282	(<618)

- The percentage of buildings with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	13%	(4-22%)
Some Damaged Material	10%	(1-19%)
Some significantly Damaged Material	8%	(<18%)

- ACFM in fan/boiler rooms is often significantly damaged.

- Most friable material in fan/boiler rooms has asbestos (including both damaged and undamaged material).

- Taller buildings are more likely to have asbestos-containing friable material in fan/boiler rooms.

- Most of the buildings with asbestos-containing friable material in fan/boiler rooms have three or more floors even though most buildings covered by the survey have one or two floors.

I. INTRODUCTION

A. Background

Asbestos-containing materials were widely used in building construction until the mid 1970's. Through normal wear and tear or when such materials are disturbed, asbestos fibers may be dislodged and become airborne. The Environmental Protection Agency (EPA) has long been concerned about potential health risks from exposure to airborne asbestos fibers.

EPA responded to this situation in several ways. Under EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP)(40 CFR 61, Subpart M), EPA banned the use of all sprayed-on asbestos-containing friable materials in new construction beginning in 1979. Under the Toxic Substances Control Act, EPA promulgated the Asbestos-in-Schools Identification and Notification Rule in 1982 as part of a program to protect the nation's school children from this potential health hazard. As a result of the Asbestos Hazard Emergency Response Act of 1986 (AHERA), EPA promulgated rules, on October 17, 1987, for the regulation of asbestos in schools.

In 1984 the EPA Office of Toxic Substances completed the Asbestos in Buildings survey[5] to determine the extent to which asbestos-containing friable materials are present in public and commercial buildings. The national survey defined friable materials as including sprayed-on or trowelled-on friable material, ceiling tiles, pipe wrap, and boiler insulation. Specifically, through on-site inspections of a nationally representative sample of buildings, estimates were obtained for:

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[5] ASBESTOS IN BUILDINGS: A National Survey of Asbestos-Containing Friable Materials, EPA 560/5-84-006, United States Environmental Protection Agency, Office of Toxic Substances, Washington, D. C. 20460, October 1984

- Number of public and commercial buildings which have asbestos-containing friable materials;
- Square feet of ACFM material in such buildings[6]; and
- The percentage of asbestos in the material.

In addition separate estimates were made for different building types:

- Privately-owned nonresidential buildings;
- Federally-owned or leased buildings;
- Apartment buildings with 10 or more dwelling units;
- All non-residential buildings; and
- All buildings in the survey.

Secondary estimates were tabulated by type of building material, building height, and building age. Regional estimates or comparisons were not made, since the sample was not large enough to allow for separate estimates by region.

As part of the Asbestos in Buildings survey, the survey field staff recorded data on the condition of asbestos-containing friable material in the buildings inspected. Due to limited resources, these data were not analyzed for the 1984 Asbestos in Buildings survey report.

Congress passed the AHERA in October 1986. This act required EPA to promulgate rules for the regulation of asbestos in schools and to submit a report to Congress (under Section 213 of AHERA) within 360 days of enactment of the AHERA legislation which would:

- Assess the extent to which asbestos-containing materials are present in commercial and public buildings;
- Assess the condition of asbestos-containing material in commercial buildings; and
- Assess the likelihood that persons occupying such buildings, including service and maintenance personnel, are, or may be, exposed to asbestos fibers.

Following this mandate, in October 1987 EPA promulgated rules for the regulation of asbestos in schools, and in February 1988

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[6]This report uses English units rather than metric to be consistent with the Asbestos in Buildings report.

EPA submitted its report to Congress[7] to address the issues raised in section 213 of AHERA. EPA felt the data from the 1984 Asbestos in Buildings survey provided valuable information to address several issues raised in AHERA. Therefore an additional analysis of the condition data was performed and is presented in this report.

B. Objectives of the additional analysis

The primary objective of this report is to analyze data collected in the 1984 survey on the condition of asbestos-containing friable material. Three categories of ACFM are defined: present, damaged, and significantly damaged. The prevalence of material in each category is estimated by the following four measures:

- Number of public and commercial buildings which have such materials;
- Square feet of the material in such buildings;
- Floor area in such buildings; and
- Surface area of the asbestos-containing friable material, where possible.

These four estimates are tabulated separately for the following types of asbestos-containing materials:

- Sprayed- or troweled-on friable materials;
- Ceiling tile;
- Pipe wrap and insulation found in fan and boiler rooms;
- Friable material in public areas;
- Friable material in fan and/or boiler rooms; and
- All materials combined.

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[7]EPA study of Asbestos-containing Materials in Public Buildings, A Report to Congress, U. S. Environmental Protection Agency, Washington, D. C., February, 1988.

The statistical analysis included separate estimates by:

- Building type:
  - Privately-owned, nonresidential buildings;
  - Federally owned or leased buildings;
  - Apartment buildings with 10 or more dwelling units; and
  - All buildings in the survey.
- Building height:
  - One or two floors;
  - Three to seven floors; and
  - Eight or more floors.
- Age of buildings.

Because of concern at EPA about possible asbestos in high-rise buildings, and concern about maintenance workers reflected in AHERA, some analysis categories have been slightly modified from the original survey report. Specifically, building height is divided into three categories to provide information on high-rises (defined as having 8 or more floors) and estimates are provided for two additional categories of material-- ACFM in public areas and ACFM in fan and boiler rooms.

C. Overview of the report

Section 2 summarizes the major findings of the additional analyses. Section 3 gives background on the data base and statistical methods. Section 4 gives the detailed tables of results.

II. CONCLUSIONS

The major conclusions of the additional analysis follow. They are grouped by type of material and location. The first set of conclusions groups the main conclusions of all types of material.

MAJOR CONCLUSIONS FOR ASBESTOS-CONTAINING FRIABLE MATERIAL OF ANY TYPE

- The number of buildings (in 1,000's) with asbestos-containing friable material of any type by condition of material is:

Present	733	(499-966)
Some Damaged Material	501	(201-801)
Some significantly Damaged Material	317	(<679)

- The percentage of buildings with asbestos-containing friable material of any type by condition of material is:

Present	20%	(14-27%)
Some Damaged Material	14%	(6-22%)
Some significantly Damaged Material	9%	(<19%)

- Taller buildings are more likely to have asbestos-containing friable material.

- Most buildings with asbestos-containing friable material are private non-residential buildings, about half of which have one or two floors and half have three or more floors. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

MAJOR CONCLUSIONS FOR SPRAYED- OR TROWELED-ON ASBESTOS-CONTAINING FRIABLE MATERIAL

- The number of buildings (in 1,000's) with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	192	(18-365)
Some Damaged Material	55	(<129)
Some significantly Damaged Material	<.5	(<1)

- The percentage of buildings with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	5%	(0.5%-10%)
Some Damaged Material	2%	(<4%)
Some significantly Damaged Material	<.5%	(<.5%)

- There are so few buildings with damaged sprayed- or trowelled-on ACFM in the sample that a comparison of this damaged material by building type or height is not reliable.

- Most of the buildings with asbestos-containing sprayed- or trowelled-on friable material have one or two floors or are commercial/private non-residential. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- Forty-one percent of high-rise buildings have asbestos-containing sprayed- or trowelled-on friable material, a much higher rate than the five percent for all buildings in the survey.

- Most of the surface area of the damaged asbestos-containing sprayed- or trowelled-on friable material is in buildings with one or two floors.

- Most of the floor area associated with buildings with asbestos-containing sprayed- or trowelled-on friable material is in high-rise buildings (8 or more floors).

- For buildings with asbestos-containing sprayed- or troweled-on friable material the ratio of surface area of material to floor area of the buildings decreases with increasing building height category.

MAJOR CONCLUSIONS FOR ASBESTOS-CONTAINING PIPE WRAP AND BOILER INSULATION

- The number of buildings (in 1,000's) with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	563	(239-888)
Some Damaged Material	453	(112-793)
Some significantly Damaged Material	317	(<679)

- The percentage of buildings with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	16%	(7-25%)
Some Damaged Material	13%	(3-22%)
Some significantly Damaged Material	9%	(<19%)

- Federal and residential buildings are more likely to have asbestos-containing pipe wrap or boiler insulation than private non-residential buildings.

- Presence of asbestos-containing pipe wrap or boiler insulation is more strongly related to building height than building type.

- Most of the buildings with asbestos-containing pipe wrap or boiler insulation have three to seven floors, unlike the overall distribution of buildings which is dominated by one and two floor buildings.

- Roughly 58 percent of buildings with pipe wrap or boiler insulation have asbestos-containing pipe wrap or boiler insulation.

- Of the buildings with asbestos-containing pipe wrap and boiler insulation, most appear to have damaged asbestos-containing pipe wrap or boiler insulation.

- All of the 19 high-rise buildings (8 or more floors) in the sample had asbestos-containing pipe wrap or boiler insulation.

MAJOR CONCLUSIONS FOR ASBESTOS-CONTAINING FRIABLE MATERIAL IN PUBLIC AREAS

- The number of buildings (in 1,000's) with asbestos-containing friable material in public areas by condition of material is:

Present	454	(337-531)
Some Damaged Material	272	(160-384)
Some significantly Damaged Material	85	(<227)

- The percentage of buildings with asbestos-containing friable material in public areas by condition of material is:

Present	13%	(10-15%)
Damaged Material	8%	(4-11%)
Some significantly Damaged Material	2%	(<7%)

- The ACFM in public areas occurs mostly in private non-residential buildings with one or two floors. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- Federal and residential buildings are more likely to have ACFM in public areas than are private non-residential buildings.

- A higher percentage of high-rises have ACFM in public areas than do buildings with one or two floors.

MAJOR CONCLUSIONS FOR ASBESTOS-CONTAINING FRIABLE MATERIAL IN FAN AND BOILER ROOMS

- The number of buildings (in 1,000's) with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	462	(145-779)
Some Damaged Material	360	(33-688)
Some significantly Damaged Material	282	(<618)

- The percentage of buildings with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	13%	(4-22%)
Some Damaged Material	10%	(1-19%)
Some significantly Damaged Material	8%	(<18%)

- Taller buildings are more likely to have asbestos-containing friable material in fan/boiler rooms.

- Most of the buildings with asbestos-containing friable material in fan/boiler rooms have three or more floors even though most buildings covered by the survey have one or two floors.

- ACFM in fan/boiler rooms is often significantly damaged.

- Most friable material in fan/boiler rooms has asbestos (including both damaged and undamaged material).

- Most buildings with friable material in fan/boiler rooms have damaged ACFM in those fan/boiler rooms. This relationship is stronger in high-rises.

MAJOR CONCLUSIONS FOR ASBESTOS-CONTAINING CEILING TILE

While an estimated 62 percent of buildings have ceiling tile, only 0.1 percent of buildings have asbestos-containing ceiling tile and fewer still have damaged asbestos-containing ceiling tile. Thus the survey sample has little useful information about the condition or description of buildings with asbestos-containing ceiling tile other than that there are few such buildings. Therefore, no estimates are presented for asbestos-containing ceiling tile separately, although the available data are included in the tables for asbestos-containing friable material of any type and asbestos-containing friable materials in public areas. No

buildings in the sample had asbestos-containing ceiling tile in fan or boiler rooms.

III. STATISTICAL METHODS AND INTERPRETATION

A. Summary of the survey procedures

The 231 buildings selected for this survey form a nationally-representative, probability sample of all buildings in the target universe. The methods used to develop sampling frames and select the sampled buildings are discussed in detail in the Asbestos in Buildings survey report referenced (Sections 4 and 5, and Appendices). The survey site visits were conducted during 1983. The sample frame was developed from lists of buildings compiled in the period 1980 to 1983, depending on the source. The date at which the frame was current does not affect the results since only buildings built prior to 1979 were considered for the survey.

The target population consisted of buildings in the continental United States falling into one of three strata, with certain general exclusions. Buildings with mixed use were classified by the use which occupied at least half of the building. The three strata are:

1. Federal Government -- Owned or operated by a civilian agency of the Federal Government.

2. Residential -- A rental apartment building with 10 or more dwelling units.

3. Commercial/private non-residential -- A privately-owned building used for nonresidential purposes. Includes commercial retail and office space and buildings such as churches, auditoriums, etc.

The exclusions to the study universe are:

1. Buildings built after January 1, 1979 -- These buildings were banned by law from containing any asbestos-containing sprayed-on or troweled-on materials.

2. Vacant buildings and warehouses -- These buildings were excluded because they were not occupied.

3. Buildings owned or operated by the military.

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4. Elementary and secondary schools -- Schools are studied and regulated under a separate EPA program.

5. State and local government buildings -- There is no reason to believe that these buildings are different in terms of asbestos-containing friable materials from other buildings surveyed and adequately represented in the Federal Government and non-residential samples. Based on the Asbestos in Buildings survey report, these buildings are estimated to comprise less than 2.5 percent of all buildings.

The data presented in this report are based on a sample survey. Advantages of such data include: a defined target universe to which estimates apply; specified and uniform building inspections, definitions, and decisions as to material being studied; controlled laboratory analyses with an explicit quality control plan; and the ability to measure the sampling error of the estimates.

As with all survey data, the estimates are subject to sampling error, which has been estimated from the survey data and is presented in terms of 95 percent confidence limits for important estimates. Some readers may find the confidence bounds in this survey to be too wide for their purposes. The width of the confidence intervals is determined by the sample design and the sample size. The sample design and sample size chosen for the survey were adequate for the objectives of the original survey, which did not specify the confidence interval width of estimates for damaged and significantly damaged material. The statistical analysis plan for the additional analysis included the estimation of sampling error and confidence intervals for the more important estimates of the additional analysis.

In addition to sampling error, the data will also be subject to non-sampling error, such as frame errors, potential bias introduced by substitution of buildings, inspection or laboratory error, and errors in data collection, transcription, keypunching, etc. The quality assurance plan provided ways of guarding against such errors and in some cases measures of the extent of such errors. There is no evidence that non-sampling errors have contributed any substantial bias to the estimates. In particular, substitution of buildings, a potential source of non-sampling error, was minimal because of the excellent response rate of the

original sample[8]. Another possible source of non-sampling error, misclassification of the condition, is discussed in the next section.

B. Condition codes

The condition of the asbestos was rated in the field by the two field inspectors. The same condition codes were used whether the area was within a fan/boiler room or outside of the fan/boiler room. The condition code from the survey is defined on a relative scale from 1 (Best) to 5 (Worst), with no associated quantitative descriptions for each code. The two field inspectors were contacted by telephone in 1987 to determine, as best as possible, a description of the ACFM for each condition code used in the original and to assess the consistency between raters. The inspectors descriptions of condition codes, though somewhat vague due to the passage of time, are given in Table 1.

The inspectors were also asked to relate the Asbestos in Buildings survey condition codes to the categories used in the EPA's document, "Guidance for Assessing and Managing Exposure to Asbestos in Buildings."[9] Both surveyors used the same ratings. These are:

Hazard Condition Category	Survey Condition Code
Good Condition	1 and 2
Moderate Damage	3 and 4
Significant Damage	5

The data analysis reported here used survey condition codes of 3, 4, and 5 for damaged ACFM asbestos, and condition code 5 for significantly damaged ACFM. Note that a building is classified by the most damaged asbestos-containing material of the type being tabulated and that a building can be counted in several

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[8]The response rate overall was 88%, with 100% response rate for Federal buildings and 83% for non-Federal buildings.

[9]GUIDANCE FOR ASSESSING AND MANAGING EXPOSURE TO ASBESTOS IN BUILDINGS, SEVENTH DRAFT REPORT by Dale Keyes, Bertram Price and Jean Chesson, prepared for EPA Office of Pesticides and Toxic Substances by Battelle - Washington Operations, 2030 M Street, NW, Washington, DC 20036

Table 1 Description of the condition codes assigned by the two field inspectors.

Survey Condition Code	Inspector's Description
1	Excellent: no damage at all.
2	Very good: 0-10% damaged. Surfacing: small area with water spots or flaking Pipe wrap: hole or tear
3	Good: 0-10% damaged (perhaps should be 10-15%) Surfacing: larger area damaged, some loose, falling off.
4	Fair: 10-50% damaged (perhaps should be 15-50%) Pipe wrap: tape coming off pipe, lot of exposure
5	Poor: 50-100% damaged. Material flakes spontaneously, much damage.

Survey Condition Code	Inspector's Description
1	Surfacing: no damage, "feels clean". Pipe wrap: painted, no damage.
2	Surfacing: some damage, sloughing, minor water spots, or other blemish. Pipe wrap: a few "dings".
3	Surfacing: average condition, some degradation of binder. Pipe wrap: average wear.
4	Surfacing: no doubt about the need to do something. Pipe wrap: "ratty".
5	Surfacing: very far gone. Pipe wrap: very "ratty".

categories. Thus, a building with significantly damaged material will be counted in tabulations for buildings with significantly damaged material, buildings with damaged material and buildings with any ACFM. Since the amount of damaged material in a building was not recorded, a building with some damaged material (at least some material with condition codes 3, 4, or 5) may also contain material in good condition (condition codes 1 and 2). Similarly, a building with some significantly damaged material may also have material in good or moderately damaged (condition codes 3 and 4) condition.

Because the condition codes are defined on a relative scale, the interpretation of the estimates and the confidence intervals (based only on sampling error only) depends on a subjective evaluation of the accuracy and usefulness of the condition codes. This subjective evaluation will depend on the information in Table 1 and the extent to which it is believed that the inspectors can reliably distinguish different condition categories.

C. Relationship to AHERA

The language of AHERA uses the phrase "likelihood of exposure"; however, this term is not defined in the legislation. Nevertheless, from common usage we might reasonably make the following statements about the likelihood of exposure to asbestos fibers:

Other things being equal, the likelihood of exposure to asbestos fibers increases as:

- The number of buildings with asbestos increases;
- The amount of asbestos in the buildings increases;
- Damage to the asbestos material increases;
- The asbestos content of the material increases;
- The number of occupants in the building increases;
- The proximity to air flows which might disturb loose asbestos particles increases; and
- The usage of asbestos-containing work spaces increases.

The Asbestos in Buildings survey data provide information related to the first four items above. If we can assume that the number of people in a building is roughly proportional to the

floor area of the building, the survey also provides information related to the fifth item. The asbestos content of the material is addressed in the Asbestos in Buildings survey report (pages 7 through 15).

This report provides data on the following measures:

- o Number of buildings;
- o Surface area of sprayed- or trowelled-on ACFM; and
- o Square feet of floor area in buildings with ACFM.

Considered as measures of "likelihood of exposure" each of these measures might have the following interpretations:

(1) The presence/absence of damaged ACFM in a building -- This measure of exposure is the same regardless of the number of people in the building, the amount of asbestos in the building or the size of the building. Therefore, it measures exposure for an occupant exposed to the most damaged asbestos material in the building (see tables for Number of Buildings and Percentage of Buildings).

(2) The amount of damaged asbestos-containing friable material in the building (square feet surface area of ACFM) -- This measure of exposure is the same regardless of the size of the building or the number of occupants. If the number of asbestos fibers released is proportional to the surface area of the ACFM, this measures the aggregate exposure of all people in the building to fibers from damaged asbestos (see tables for Surface Area of Friable Material).

(3) The square feet of floor area for buildings with damaged asbestos-containing friable material -- This measure of exposure is the same regardless of the amount or type of ACFM in the building. If the number of people in the building is proportional to the floor area, this measures the number of people in the building who might be exposed to fibers from damaged asbestos (see tables for Floor Area of Buildings).

D. Statistical methods

The calculation of the numbers in the tables followed the same basic procedures as used in the Asbestos in Buildings survey analysis. The sampling weights from the survey were used to calculate national statistical estimates. Confidence intervals were calculated using the method of balanced repeated replication.

Because five percent of the condition codes are missing in the original data base, the calculations for damaged and significantly damaged material required adjustments. The national estimates of the surface area of sprayed- or trowelled-on ACFM were made by assuming that the distribution of condition codes for the sample areas with missing condition codes is the same as for sample areas with known condition codes. The national estimates for number of buildings and floor area were made by assuming that the fraction of buildings with a specific characteristic is the same for buildings with missing condition codes and buildings with known condition codes. The distribution of the missing condition codes were assumed the same for all building heights and types.

Due to differing patterns of missing condition codes for different types of ACFM, the procedures used for imputation resulted in slightly inconsistent results between different types of ACFM. For instance, the number of buildings with any significantly damaged asbestos-containing friable material and with one or two floors is estimated as 107 thousand. The corresponding number that contain just pipe wrap and boiler insulation is 108 thousand. Logic would indicate that the number of buildings with asbestos-containing pipe wrap and boiler insulation is less than or equal to the number with any ACFM. The difference is due to differing patterns of missing condition codes between buildings with any ACFM and those with just asbestos-containing pipe wrap and boiler insulation. The differences are small compared to the associated sampling error of the estimates.

The quality of the numbers presented in the tables was checked by using uniform procedures for calculating all tables, checking intermediate results, comparing the results to comparable values from the Asbestos in Buildings survey report, and double checking the printed values. The only discrepancy identified was a difference in the third decimal place between the number of 1 or 2 floor buildings with ACFM as reported here and in the Asbestos in Buildings survey report. The difference may be due to rounding error. After review, the number reported here was determined to be correct.

E. Interpretation

Confidence intervals have been calculated for the statistical estimates for all buildings. Where available from the 1984 Asbestos in Buildings survey report, other confidence intervals are also provided. The confidence intervals are shown in parentheses after the associated estimate.

Confidence intervals have not been calculated for the categorical breakdowns by type of building or height of building. For some categories of buildings, particularly buildings with eight or more floors, there are relatively few buildings in the survey data, and thus the estimates will have large confidence intervals. Qualitative conclusions reported for these categories of buildings are based on the patterns of the data across categories and approximate confidence intervals based on the marginal confidence intervals and the number of buildings in the sample in each building category. These qualitative conclusions have no associated confidence probability.

IV. RESULTS

A. Introduction to the tables

This section presents the results of the additional analysis of data collected in the national survey. The analysis focused on the condition of asbestos-containing materials in different types of buildings.

Some findings of the national survey put these figures in perspective.

- There are roughly 3.6 million buildings nationally in the universe represented by the survey.
- Of these buildings, approximately 2.7 million have sprayed- or trowelled-on friable materials, or friable materials used in pipe wrap, boiler insulation, or ceiling tiles.
- Of the buildings with friable materials, roughly 733 thousand have asbestos-containing friable material.

This report focuses on the 733 thousand buildings nationally with asbestos-containing friable material.

Corresponding to the national figures above, there were 231 buildings surveyed, of which 189 had friable material and 97 had asbestos-containing friable material. Of those with asbestos-containing friable material, 59 had damaged ACFM and 13 had significantly damaged ACFM.

Organization of the tables

The first four tables provide background for the main results. Tables 3 and 4 present the number of buildings overall, the number with friable material, and the number with asbestos-containing friable material by building type and height.

Tables 5 and 6 allow a comparison between different types of material. These tables present the number of buildings and percentage of buildings with different types of friable, asbestos-containing friable, and damaged asbestos-containing friable materials. The data in these tables appear elsewhere in the report.

Tables 7 through 38 are organized to allow comparison of all material, damaged material, and significantly damaged material. Each table describes the data for only one type of material and one summary statistic. The results are broken down by building type and height.

The types of material are:

- All friable materials;
- Sprayed- or trowelled-on friable material (in public areas);
- Pipe wrap and boiler insulation (in both public areas and fan and boiler rooms);
- Friable material in public areas (includes sprayed- or trowelled-on friable material, ceiling tiles, and pipe wrap outside of fan and boiler rooms);
- Friable material in fan/boiler rooms; and
- Ceiling tile (in public areas).

National estimates are presented for the following summary statistics:

- Number of buildings;
- Percentage of buildings;
- Floor area of building; and
- Surface area of sprayed- or trowelled-on friable material.

Note that a building is categorized by the ACFM in the worst condition. Also note that the floor area of buildings with ACFM should not be confused with the surface area of sprayed- or trowelled-on friable material in public areas, which may occupy a very small proportion of the building.

The tables of percentages show the number of buildings as a percentage of buildings with the height or type indicated, as opposed to a percentage of all buildings. The percentages will

therefore not add to the corresponding percentage for "All Buildings."

Table 2 provides a guide to locating tables by category of ACFM, measure, and building classification factors. This is a comprehensive table indexing tables 7 through 38 of the report.

Table 2 Guide to locating tables.

		Building Classification Factors	
Category of ACFM	Measure	Building Type	Height
Any Type	Number	Table 7	Table 8
	Percent	Table 9	Table 10
	Floor Area	Table 11	Table 12
	Surface Area	-	-
Sprayed- or Trowelled-on Friable Material	Number	Table 13	Table 14
	Percent	Table 15	Table 16
	Floor Area	Table 17	Table 18
	Surface Area	Table 19	Table 20
Pipe Wrap and Boiler Insulation	Number	Table 21	Table 22
	Percent	Table 23	Table 24
	Floor Area	Table 25	Table 26
	Surface Area	-	-
Public Areas	Number	Table 27	Table 28
	Percent	Table 29	Table 30
	Floor Area	Table 31	Table 32
	Surface Area	-	-
Fan/Boiler Rooms	Number	Table 33	Table 34
	Percent	Table 35	Table 36
	Floor Area	Table 37	Table 38
	Surface Area	-	-

Additional Comments

Based on the survey data and additional analysis, pipe wrap and boiler insulation (damaged or not) is more prevalent than sprayed- or trowelled-on asbestos-containing friable material. However, it is difficult to compare the likelihood of exposure attributable to the two types of material. Other factors must also be considered:

- Typical asbestos fiber content of pipe wrap is 70 percent. Typical asbestos content of sprayed- or trowelled-on asbestos-containing friable material is 14 percent.

- The surface area of exposed sprayed- or trowelled-on asbestos-containing friable material may be much greater than the surface area of exposed pipe wrap and boiler insulation.

The analysis of the data by age of the buildings and condition of the asbestos-containing friable material was completed; however those results are not shown here because:

- The distribution of ACFM by building age is presented in the Asbestos in Buildings survey report (pages 7 through 20); and

- The only conclusion to be drawn from the breakdown by condition of the ACFM was that the likelihood of damage to the material increases with age.

Table 3 Estimated **number of buildings** (in 1,000's) in the continental U.S. falling into categories defined by building types, presence of friable material, and presence of asbestos-containing friable material. (See notes below)

(95% confidence intervals are shown in parentheses)

	Building Description		
Building Type	All Buildings	Buildings with Friable Material	Buildings with ACFM
Federal	35 (20-49)	32	14 (8-20)
Residential (10+ rental units)	350 (269-432)	263	208 (119-297)
Commercial Non-residential	3221	2360	511 (274-748)
All Buildings	3606 (3533-3680)	2656	733 (499-966)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Columns may not add due to rounding.

Table 4 Estimated **number of buildings** (in 1,000's) in the continental U.S. falling into categories defined by building height, presence of friable material, and presence of asbestos-containing friable material. (See notes below)

(95% confidence intervals are shown in parentheses)

	Building Description		
Building Height	All Buildings	Buildings with Friable Material	Buildings with ACFM
1 or 2 Floors	3080 (2750-3411)	2189	353 (232-473)
3 to 7 Floors	498	439	352
8 or more Floors	28	28	28
All Buildings	3606 (3533-3680)	2656	733 (499-966)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Columns may not add due to rounding.

Table 5 Estimated **number of buildings** (in 1,000's) in the continental U.S. with at least some friable material falling into categories defined by material type, presence of asbestos, and condition. (See notes below)

(95% confidence intervals are shown in parentheses)

	Material Description		
Type of Material	Any Friable Material	Asbestos-Containing Friable Material	Damaged ACFM
Sprayed- or Trowelled-on Material	697	192 (18-365)	55 (<129)
Ceiling Tile	2217	2 (<6)	<2
Pipe Wrap and Boiler Insulation	971	563 (239-888)	453 (112-793)
Friable Material in Public Areas	2600	454 (499-966)	272 (160-384)
Friable Material in Fan Boiler Rooms	468	462 (145-779)	360 (33-688)
Any Friable Material	2656	733 (499-966)	501 (201-801)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Columns will not add.

Table 6 Estimated **percent of buildings** in the continental U.S. with at least some friable material falling into categories defined by material type, presence of asbestos, and condition. (See notes below)

(95% confidence intervals are shown in parentheses)

	Material Description		
Type of Material	Any Friable Material	Asbestos-Containing Friable Material	Damaged ACFM
Sprayed- or Trowelled-on Material	19%	5% (.5-10%)	2% (<4%)
Ceiling Tile	62%	.1% (<.2%)	<.1%
Pipe Wrap and Boiler Insulation	27%	16% (7-25%)	13% (3-22%)
Friable Material in Public Areas	72%	13% (10-15%)	8% (4-11%)
Friable Material in Fan Boiler Rooms	13%	13% (4-22%)	10% (1-19%)
Any Friable Material	74%	20% (14-27%)	14% (6-22%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

<.1% indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

B. Asbestos-containing friable material of any type

This section presents estimates for the number (Tables 7 and 8) and percentage (Tables 9 and 10) of buildings with any asbestos-containing materials. It also presents the floor area of those buildings (Tables 11 and 12). Highlights of the findings on asbestos-containing friable materials are:

- The number of buildings (in 1,000's) with asbestos-containing friable material of any type by condition of material is:

Present	733	(499-966)
Some Damaged Material	501	(201-801)
Some significantly Damaged Material	317	(<679)

- The percentage of buildings with asbestos-containing friable material of any type by condition of material is:

Present	20%	(14-27%)
Some Damaged Material	14%	(6-22%)
Some significantly Damaged Material	9%	(<19%)

- Taller buildings are more likely to have asbestos-containing friable material.

- Most buildings with asbestos-containing friable material are private non-residential buildings, about half of which have one or two floors and half have three or more floors. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

Table 7 Estimated **number of buildings** (in 1,000's) in the continental U.S. with **asbestos-containing friable material of any type** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	14 (8-20)	5	<.5
Residential (10+ rental units)	208 (119-297)	80	7
Commercial Non-residential	511 (274-748)	416	310
All Buildings	733 (499-966)	501 (201-801)	317 (<679)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 8 Estimated **number of buildings** (in 1,000's) in the continental U.S. with **asbestos-containing friable material of any type** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	353 (232-473)	209	106
3 to 7 Floors	352	270	208
8 or more Floors	28	22	3
All Buildings	733 (499-966)	501 (201-801)	317 (<679)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 9 Estimated **percentage of buildings** in the continental U.S. with **asbestos-containing friable material of any type** with the condition indicated (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	39% (29-48%)	14%	1%
Residential (10+ rental units)	59% (45-74%)	23%	2%
Commercial Non-residential	16% (9-23%)	13%	10%
All Buildings	20% (14-27%)	14% (6-22%)	9% (<19%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 10 Estimated **percentage of buildings** in the continental U.S. with **asbestos-containing friable material of any type** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	11%	7%	3%
3 to 7 Floors	71%	54%	42%
8 or more Floors	100%	78%	9%
All Buildings	20% (14-27%)	14% (6-22%)	9% (<19%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 11 Estimated **floor area** of buildings (in 1,000,000's of square feet) in the continental U.S. with **asbestos-containing friable material of any type** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	588	271	7
Residential (10+ rental units)	5741	3114	324
Commercial Non-residential	12312	9645	6681
All Buildings	18641 (11740-25540)	13030 (8914-17146)	7012 (4062-9961)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 12 Estimated **floor area** of buildings (in 1,000,000's of square feet) in the continental U.S. with **asbestos-containing friable material of any type** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	6138	3180	1189
3 to 7 Floors	7137	5376	3347
8 or more Floors	5366	4474	2475
All Buildings	18641 (11740-25540)	13030 (8914-17146)	7012 (4062-9961)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

C. Sprayed- or trowelled-on asbestos material

This section presents estimates for the number (Tables 13 and 14) and percentage (Tables 15 and 16) of buildings with asbestos-containing sprayed- or troweled-on friable materials. It also presents the floor area of those buildings (Tables 17 and 18) and surface area of the material (Tables 19 and 20). Highlights of the findings on asbestos-containing sprayed- or troweled-on friable materials are:

- The number of buildings (in 1,000's) with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	192	(18-365)
Some Damaged Material	55	(<129)
Some significantly Damaged Material	<.5	(<1)

- The percentage of buildings with asbestos-containing sprayed- or trowelled-on material by condition of material is:

Present	5%	(0.5%-10%)
Some Damaged Material	2%	(<4%)
Some significantly Damaged Material	<.5%	(<.5%)

- There are so few buildings with damaged sprayed- or trowelled-on ACFM in the sample that a comparison of this damaged material by building type or height is not reliable.

- Most of the buildings with asbestos-containing sprayed- or trowelled-on friable material have one or two floors or are commercial/private non-residential. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- Forty-one percent of high-rise buildings have asbestos-containing sprayed- or trowelled-on friable material, a much higher rate than the five percent for all buildings in the survey.

- Most of the surface area of the damaged asbestos-containing sprayed- or trowelled-on friable material is in buildings with one or two floors.

- Most of the floor area associated with buildings with asbestos-containing sprayed- or trowelled-on friable material is in high-rise buildings (8 or more floors).

- For buildings with asbestos-containing sprayed- or troweled-on friable material the ratio of surface area of material to floor area of the buildings decreases with increasing building height category.

Table 13 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing **sprayed- or trowelled-on friable material** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	5 (<10)	<.5	<.5
Residential (10+ rental units)	64 (34-94)	7	<.5
Commercial Non-residential	122 (<275)	47	<.5
All Buildings	192 (18-365)	55 (<129)	<.5 (<1)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 14 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing **sprayed- or trowelled-on friable material** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	165 (7-324)	48	<.5
3 to 7 Floors	14	4	<.5
8 or more Floors	12	3	<.5
All Buildings	192 (18-365)	55 (<129)	<.5 (<1)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 15 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing **sprayed- or trowelled-on friable material** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	16% (<33%)	<.5%	<.5%
Residential (10+ rental units)	18% (10-27%)	2%	<.5%
Commercial Non-residential	4% (<9%)	1%	<.5%
All Buildings	5% (0.5-10%)	2% (<4%)	<.5% (<.5%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 16 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing **sprayed- or trowelled-on friable material** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	5%	2%	<.5%
3 to 7 Floors	3%	1%	<.5%
8 or more Floors	41%	10%	1%
All Buildings	5% (0.5-10%)	2% (<4%)	<.5% (<.5%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 17 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing **sprayed- or trowelled-on friable material** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	210	13	<.5
Residential (10+ rental units)	1063	174	<.5
Commercial Non-residential	4383	911	16
All Buildings	5656 (<12908)	1097 (<2808)	16 (<51)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 18 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing **sprayed- or trowelled-on asbestos material** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	1788	755	<.5
3 to 7 Floors	541	69	<.5
8 or more Floors	3326	274	16
All Buildings	5656 (<12908)	1097 (<2808)	16 (<51)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 19 Estimated **surface area** (in 1,000,000's of square feet) of asbestos-containing **sprayed- or trowelled-on friable material** in buildings in the continental U. S. (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	71	2	<.5
Residential (10+ rental units)	537	63	<.5
Commercial Non-residential	576	296	2
All Buildings	1184 (406-1961)	361 (<911)	2 (<7)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 20 Estimated **surface area** (in 1,000,000's of square feet) of asbestos-containing **sprayed- or trowelled-on friable material** in buildings in the continental U. S. (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	859	288	<.5
3 to 7 Floors	174	42	<.5
8 or more Floors	151	31	2
All Buildings	1184 (406-1961)	361 (<911)	2 (<7)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

D. Asbestos-containing pipe wrap and boiler insulation

This section presents estimates for the number (Tables 21 and 22) and percentage (Tables 23 and 24) of buildings with asbestos-containing pipe wrap and boiler insulation (whether in fan/boiler rooms or public areas). It also presents the floor area of those buildings (Tables 25 and 26). Highlights of the findings on asbestos-containing pipe wrap and boiler insulation are:

- The number of buildings (in 1,000's) with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	563	(239-888)
Some Damaged Material	453	(112-793)
Some significantly Damaged Material	317	(<679)

- The percentage of buildings with asbestos-containing pipe wrap and boiler insulation by condition of material is:

Present	16%	(7-25%)
Some Damaged Material	13%	(3-22%)
Some significantly Damaged Material	9%	(<19%)

- Federal and residential buildings are more likely to have asbestos-containing pipe wrap or boiler insulation than private non-residential buildings.

- Presence of asbestos-containing pipe wrap or boiler insulation is more strongly related to building height than building type.

- Most of the buildings with asbestos-containing pipe wrap or boiler insulation have three to seven floors, unlike the overall distribution of buildings which is dominated by one and two floor buildings.

- Roughly 58 percent of buildings with pipe wrap or boiler insulation have asbestos-containing pipe wrap or boiler insulation.

- Of the buildings with asbestos-containing pipe wrap and boiler insulation, most appear to have damaged asbestos-containing pipe wrap or boiler insulation.

- All of the 19 high-rise buildings (8 or more floors) in the sample had asbestos-containing pipe wrap or boiler insulation.

Table 21 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	9 (<18)	5	<.5
Residential (10+ rental units)	155 (66-243)	76	7
Private Non-residential	400 (76-724)	372	310
All Buildings	563 (239-888)	453 (112-793)	317 (<679)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 22 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	191	165	107
3 to 7 Floors	344	266	209
8 or more Floors	28	22	2
All Buildings	563 (239-888)	453 (112-793)	317 (<679)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 23 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** by condition of the asbestos-containing friable material (ACFM) and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	25% (8-41%)	14%	1%
Residential (10+ rental units)	44% (26-62%)	22%	2%
Commercial Non-residential	12% (2-22%)	12%	10%
All Buildings	16% (7-25%)	13% (3-22%)	9% (<19%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 24 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	6%	5%	3%
3 to 7 Floors	69%	53%	42%
8 or more Floors	100%	78%	5%
All Buildings	16% (7-25%)	13% (3-22%)	9% (<19%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 25 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	461	265	8
Residential (10+ rental units)	5140	3051	335
Commercial Non-residential	11196	9051	6672
All Buildings	16791 (10930-22670)	12366 (8261-16472)	7015 (4005-10026)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 26 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing **pipe wrap and boiler insulation** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	4468	2583	1256
3 to 7 Floors	6963	5307	3359
8 or more Floors	5366	4476	2400
All Buildings	16797 (10930-22670)	12366 (8261-16472)	7015 (4005-10026)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; actual value may not be zero.

E. Asbestos-containing friable material in public areas

This section presents estimates for the number (Tables 27 and 28) and percentage (Tables 29 and 30) of buildings with asbestos-containing friable material in public areas. It also presents the floor area of those buildings (Tables 31 and 32). Highlights of the findings on asbestos-containing friable material in public areas are:

- The number of buildings (in 1,000's) with asbestos-containing friable material in public areas by condition of material is:

Present	454	(337-531)
Some Damaged Material	272	(160-384)
Some significantly Damaged Material	85	(<227)

- The percentage of buildings with asbestos-containing friable material in public areas by condition of material is:

Present	13%	(10-15%)
Damaged Material	8%	(4-11%)
Some significantly Damaged Material	2%	(<7%)

- The ACFM in public areas occurs mostly in private non-residential buildings with one or two floors. Note that private non-residential buildings and buildings of one or two floors are the most common types of building represented by the survey.

- Federal and residential buildings are more likely to have ACFM in public areas than are private non-residential buildings.

- A higher percentage of high-rises have ACFM in public areas than do buildings with one or two floors.

Table 27 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing friable **material in public areas** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	12	4	<.5
Residential (10+ rental units)	135	51	<.5
Commercial Non-residential	307	217	85
All Buildings	454 (337-531)	272 (160-384)	85 (<227)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 28 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing friable **material in public areas** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	285	152	67
3 to 7 Floors	143	104	17
8 or more Floors	26	16	1
All Buildings	454 (337-531)	272 (160-384)	85 (<227)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 29 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing friable **material in public areas** with the condition indicated (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	33%	11%	<.5%
Residential (10+ rental units)	39%	15%	<.5%
Commercial Non-residential	10%	7%	3%
All Buildings	13% (10-15%)	8% (4-11%)	2% (<7%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 30 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing friable **material in public areas** with the condition indicated (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	9%	5%	2%
3 to 7 Floors	29%	21%	3%
8 or more Floors	94%	55%	2%
All Buildings	13% (10-15%)	8% (4-11%)	2% (<7%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 31 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing friable **material in public areas** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	506	189	4
Residential (10+ rental units)	3861	1970	<.5
Commercial Non-residential	9321	7056	2519
All Buildings	13688 (7856-19521)	9215 (5103-13326)	2523 (<5349)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 32 Estimated **floor area of buildings** (in 1,000,000's of square feet) in the continental U.S. with asbestos-containing friable **material in public areas** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	4338	2344	962
3 to 7 Floors	4120	3102	1358
8 or more Floors	5230	3769	203
All Buildings	13688 (7856-19521)	9215 (5103-13326)	2523 (<5349)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

F. Asbestos-containing friable material in fan and boiler rooms

This section presents estimates for the number (Tables 33 and 34) and percentage (Tables 35 and 36) of buildings with asbestos-containing friable material in fan and boiler rooms. It also presents the floor area of those buildings (Tables 37 and 38). Highlights of the findings on asbestos-containing friable material in fan and boiler rooms are:

- The number of buildings (in 1,000's) with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	462	(145-779)
Some Damaged Material	360	(33-688)
Some significantly Damaged Material	282	(<618)

- The percentage of buildings with asbestos-containing friable material in fan/boiler rooms by condition of material is:

Present	13%	(4-22%)
Some Damaged Material	10%	(1-19%)
Some significantly Damaged Material	8%	(<18%)

- Taller buildings are more likely to have asbestos-containing friable material in fan/boiler rooms.

- Most of the buildings with asbestos-containing friable material in fan/boiler rooms have three or more floors even though most buildings covered by the survey have one or two floors.

- Most buildings with ACFM in fan/boiler rooms have significantly damaged ACFM in fan/boiler rooms.

- Most friable material in fan/boiler rooms has asbestos (including both damaged and undamaged material).

- Most buildings with friable material in fan/boiler rooms have damaged ACFM in those fan/boiler rooms. This relationship is stronger in high-rises.

Table 33 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	6	2	<.5
Residential (10+ rental units)	117	42	7
Commercial Non-residential	339	316	275
All Buildings	462 (145-779)	360 (33-688)	282 (<618)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 34 Estimated **number of buildings** (in 1,000's) in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	118	97	81
3 to 7 Floors	320	241	200
8 or more Floors	24	22	2
All Buildings	462 (145-779)	360 (33-688)	282 (<618)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 35 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** with the condition indicated (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	18%	7%	<.5%
Residential (10+ rental units)	33%	12%	2%
Commercial Non-residential	11%	10%	9%
All Buildings	13% (4-22%)	10% (1-19%)	8% (<18%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

<.5 indicates few or no occurrences in the sample; the actual value in the universe is small and cannot be estimated from the survey data.

Table 36 Estimated **percentage of buildings** in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** with the condition indicated (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	4%	3%	3%
3 to 7 Floors	64%	48%	40%
8 or more Floors	86%	77%	6%
All Buildings	13% (4-22%)	10% (1-19%)	8% (<18%)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns will not add.

Table 37 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** (ACFM), by condition of the ACFM and **by type of building**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Type	Present	Some or All Damaged	Some or All Significantly Damaged
Federal	317	148	1
Residential (10+ rental units)	3946	2296	337
Commercial Non-residential	10045	8298	5733
All Buildings	14309 (9052-19566)	10743 (7337-14148)	6071 (2296-9847)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

Table 38 Estimated **floor area** (in 1,000,000's of square feet) of buildings in the continental U.S. with asbestos-containing friable **material in fan and boiler rooms** (ACFM), by condition of the ACFM and **by building height**. (See notes below)

(95% confidence intervals are shown in parentheses)

	Condition of ACFM		
Building Height	Present	Some or All Damaged	Some or All Significantly Damaged
1 or 2 Floors	3128	1545	994
3 to 7 Floors	6551	4790	2682
8 or more Floors	4631	4408	2396
All Buildings	14309 (9052-19566)	10743 (7337-14148)	6071 (2296-9847)

Notes:

Asbestos-containing friable material has more than 1% asbestos.

Damaged is defined by condition codes of 3, 4, or 5.

Significantly damaged is defined by a condition code of 5.

Missing condition codes have been imputed (see section III.D) to get national totals.

Columns may not add due to rounding.

G. Asbestos-containing ceiling tile

While an estimated 62 percent of buildings have ceiling tile, only 0.1 percent of buildings have asbestos-containing ceiling tile and fewer still have damaged asbestos-containing ceiling tile. Thus the survey sample has little useful information about the condition or description of buildings with asbestos-containing ceiling tile other than that there are few such buildings. Therefore no estimates are presented for asbestos-containing ceiling tile separately, although the available data are included in the tables for asbestos-containing friable material of any type (section IV.B) and asbestos-containing friable materials in public areas (section IV.E). No buildings in the sample had asbestos-containing ceiling tile in fan or boiler rooms.

APPENDIX A. EXECUTIVE SUMMARY FROM THE NATIONAL SURVEY

ASBESTOS IN BUILDINGS: A National Survey of
Asbestos-Containing Friable Materials
United States Environmental Protection Agency
Washington, D. C. 20460, October 1984
EPA 560/5-84-006

EXECUTIVE SUMMARY

The U. S. Environmental Protection Agency's Office of Toxic Substances (OTS) has an ongoing program concerning asbestos in buildings. As part of this program, a national survey of materials in buildings was conducted. The survey was an effort to deal with the broad problem of public exposure to asbestos-containing friable materials. Previous estimates of the number of buildings that contain asbestos ranged from 5 to 45 percent with an unknown degree of accuracy because they were based on anecdotal information or expert opinion. No valid national estimates had been generated and this wide range did not satisfy the Agency's information needs. Thus, a national survey was undertaken to produce more precise and statistically valid estimates with a known degree of accuracy that can be used to support OTS' technical assistance and regulatory programs.

The survey's primary objective was to determine the extent of the use of friable asbestos-containing materials in buildings and the amount of asbestos in them. A secondary objective was to determine how many buildings have asbestos-containing floor and ceiling tiles and the approximate square footage of each. To accomplish these objectives, the survey was designed to: (1) estimate the number and percent of buildings with asbestos-containing friable material; (2) estimate the square footage of such material; and (3) estimate the percent asbestos content of the material. The estimates were to be made at specified levels of accuracy, and estimates of their precision were also to be made. These estimates were made for three types of buildings: Federal government (owned or operated by a civilian agency); residential (with 10 or more rental units); and private nonresidential (largely commercial--office, retail and other). Additional information was gathered including data on ceiling tile, pipe or boiler insulation, floor tile and building characteristics.

The survey involved five major areas of work: the development of a survey design, the design and implementation of a quality assurance program, the execution of a field survey, the laboratory analysis of field samples, and the statistical analysis and interpretation of the data.

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The study was conducted in 10 sites (cities or groups of counties) chosen with probability sampling to represent the continental U.S. A total of 231 buildings was inspected, with about half being private nonresidential, one-quarter residential, and one-quarter Federal government. A total of 1,514 bulk samples was taken. The sample of buildings was chosen so that separate estimates could be made for each type of building. Although survey participation was not mandatory, a high rate of cooperation was achieved -- 88 percent of initially sampled eligible buildings were inspected. Replacements for those buildings that did not participate were identified and substituted.

Each sampled building was thoroughly inspected for the presence of materials which might contain asbestos: sprayed- or troweled-on friable materials, ceiling tile, pipe and boiler insulation, and vinyl floor tile. A bulk sample was taken of any such material found, and all bulk samples except floor tile samples were analyzed for asbestos content. Pipe wrap was sampled at elbows, pipe ends and damaged spots, to estimate asbestos content of exposed material. Undamaged material not at elbows or valves may have lower percent asbestos content. The analysis was carried out using Polarized Light Microscopy; the identity of the fibers was determined by optical characteristics according to an established protocol. Vinyl floor tile was sampled whenever found. The results of those analyses are not yet available, and will be presented in a separate publication. During the building inspection, auxiliary data such as date of construction and number of floors was also recorded.

The major study findings are summarized below. The term asbestos-containing friable material refers collectively to sprayed- or troweled-on friable material, ceiling tile, and/or pipe and boiler insulation. Results pertaining to one of these types of material specifically reference the particular material type. The term "all buildings" refers to estimates based on survey data appropriately weighted to the defined target universe. There are two important exclusions from this universe. One is primary and secondary schools, which are studied and regulated under a separate EPA program. The other excluded buildings are those owned or occupied primarily by agencies of state or local governments, which may be a sizable number of buildings (there are no published estimates of the exact number).

The figures given here are estimates and, as such, are imperfect measures. In general, survey estimates are subject to sampling error and non-sampling error. Ranges given in parentheses following estimates represent the 95 percent confidence limits for the estimates due to sampling error. This means that there is only a five percent chance that actual values fall outside of this range. Potential sources of non-sampling error are discussed in Section 3.

- About 20 percent (14-27%) of all buildings have some type of asbestos-containing friable material. This represents 733,000 (499,000-966,000) buildings.

- Five percent (0.5-10%) of buildings have asbestos-containing sprayed- or troweled-on friable material, accounting for 192,000 (18,000-365,000) buildings.

- Sixteen percent (6-25%) of buildings, or 563,000 (239,000-888,000) buildings have asbestos-containing pipe and boiler insulation. This material is generally limited to closed, restricted-access areas rather than offices or other highly-used space.

- The amount of sprayed- or troweled-on asbestos-containing material is estimated at 1,184 million square feet (406-1,961 million square feet).

- The average percent asbestos content (weighted by square footage of material) in asbestos-containing sprayed- or troweled-on friable material was 14 percent (7-21%). For asbestos-containing pipe and boiler insulation material, the average percent asbestos content was 70 percent (66-74%).

- Rental residential and Federal government buildings had a higher incidence of asbestos-containing friable materials than private nonresidential buildings. These two types of buildings account for 11 percent of the total population of buildings.

- Very few buildings had asbestos-containing ceiling tile (less than 0.5% of buildings). The square footage of asbestos-containing ceiling tile is also low, an estimated 3.6 million square feet (less than 7.8 million square feet), and the average asbestos content of the asbestos-containing ceiling tile that was found was quite low, averaging three percent (less than 8%).

- Buildings built in the sixties are more likely to have asbestos-containing sprayed- or troweled-on friable material (15% of such buildings do), than other buildings. It appears that the extensive use of asbestos-containing sprayed-on friable material would have continued and perhaps increased in the 1970's had not the EPA banned the use of those materials for all but decorative purposes in 1973. In 1978, the EPA banned all other uses of these materials. Older buildings are more likely than newer ones to have asbestos-containing pipe and boiler insulation.

- No significant differences in percent asbestos content were found by building height or construction type (masonry, frame, or steel beam).

The quality assurance program covered all aspects of the study. Personnel working on the study were chosen for their qualifications and experience and were given specific training in survey tasks. Protocols and manuals were prepared and followed for every aspect of the work. The fieldwork was conducted with extensive telephone supervision and site visits. The laboratory analysis had both internal and external laboratory checks with excellent agreement.